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[54] CONTAINER HANDLING APPARATUS FOR A REFUSE COLLECTION VEHICLE

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294/106; 414/409; 414/422

[58] Field of Search **294/68.3, 88, 99.1,**
294/106, 115, 116, 902; 414/403, 406, 408, 409,
422, 555, 619-621, 729, 733, 739

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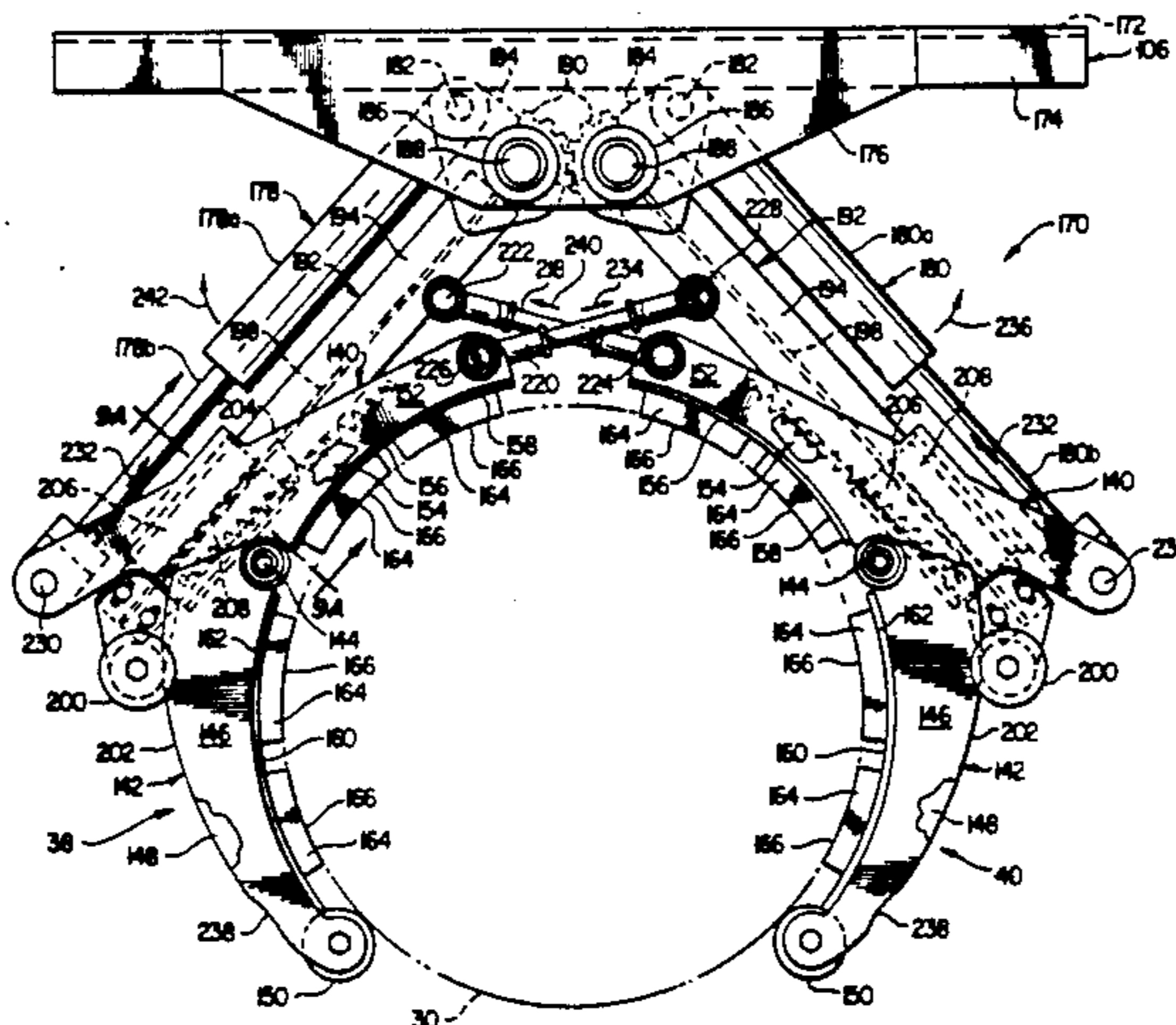
Primary Examiner—**Johnny D. Cherry**

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[57] **ABSTRACT**

A mechanized container handling system on a motorized refuse collection vehicle includes a horizontally extensible and retractable support structure having an outer end on which a container grasping assembly is carried, and a container elevating and dumping assembly for lifting the grasped container and dumping its contents into an elevated hopper opening of the vehicle. The support structure comprises telescoped inner, intermediate and outer sections interconnected by an extension scissors structure, the intermediate section being horizontally driven by a hydraulic actuator and the scissors structure being operative to responsively extend and retract the outer section. The container elevating and dumping system is driven by a hydraulic piston and gear system positioned between the upper ends of a pair of support tracks and drivingly connected to a pair of articulated container lifting force arms. The container grasping assembly includes a pair of hydraulically pivotable articulated engagement arms having a spaced series of resilient container gripping members secured to inner side surfaces thereof, for liftingly engaging cylindrical refuse containers, and suitable engagement structure may be added for handling larger rectangular containers. The power and control portions of the hydraulic system used to operate the apparatus may be conveniently housed in a lift-off module detachably secured to the refuse collection vehicle.

34 Claims, 5 Drawing Sheets



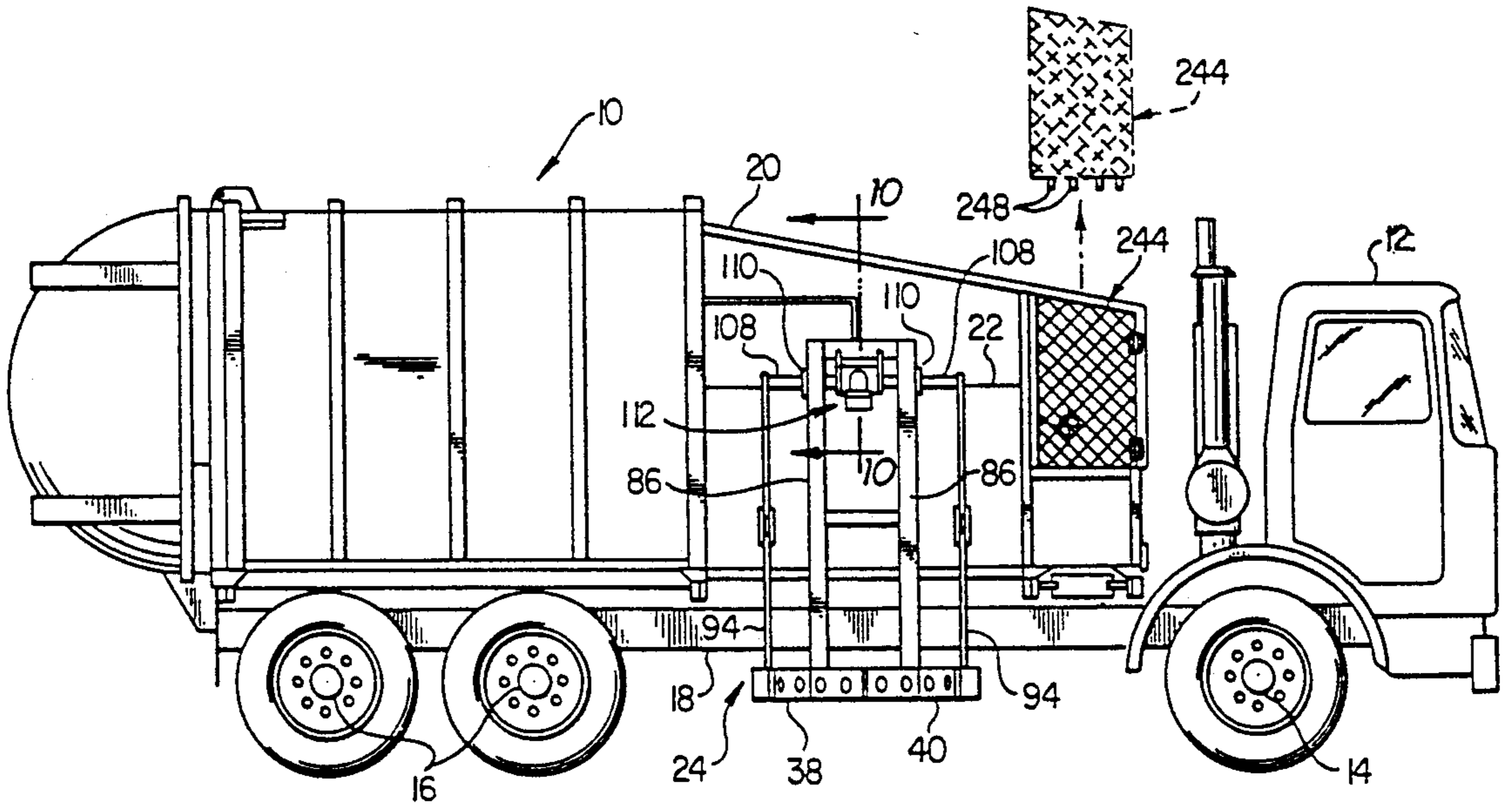


FIG. 1

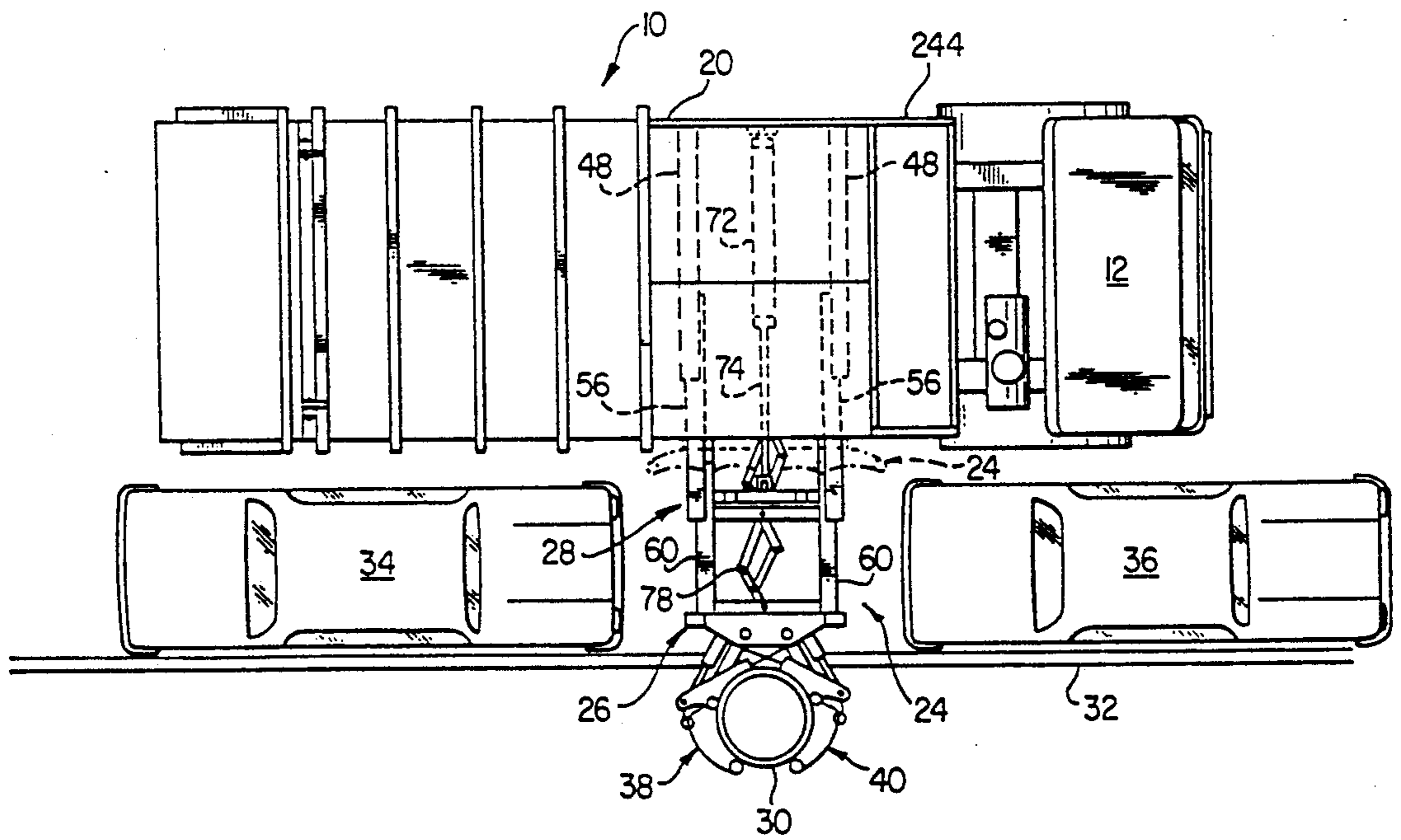


FIG. 2

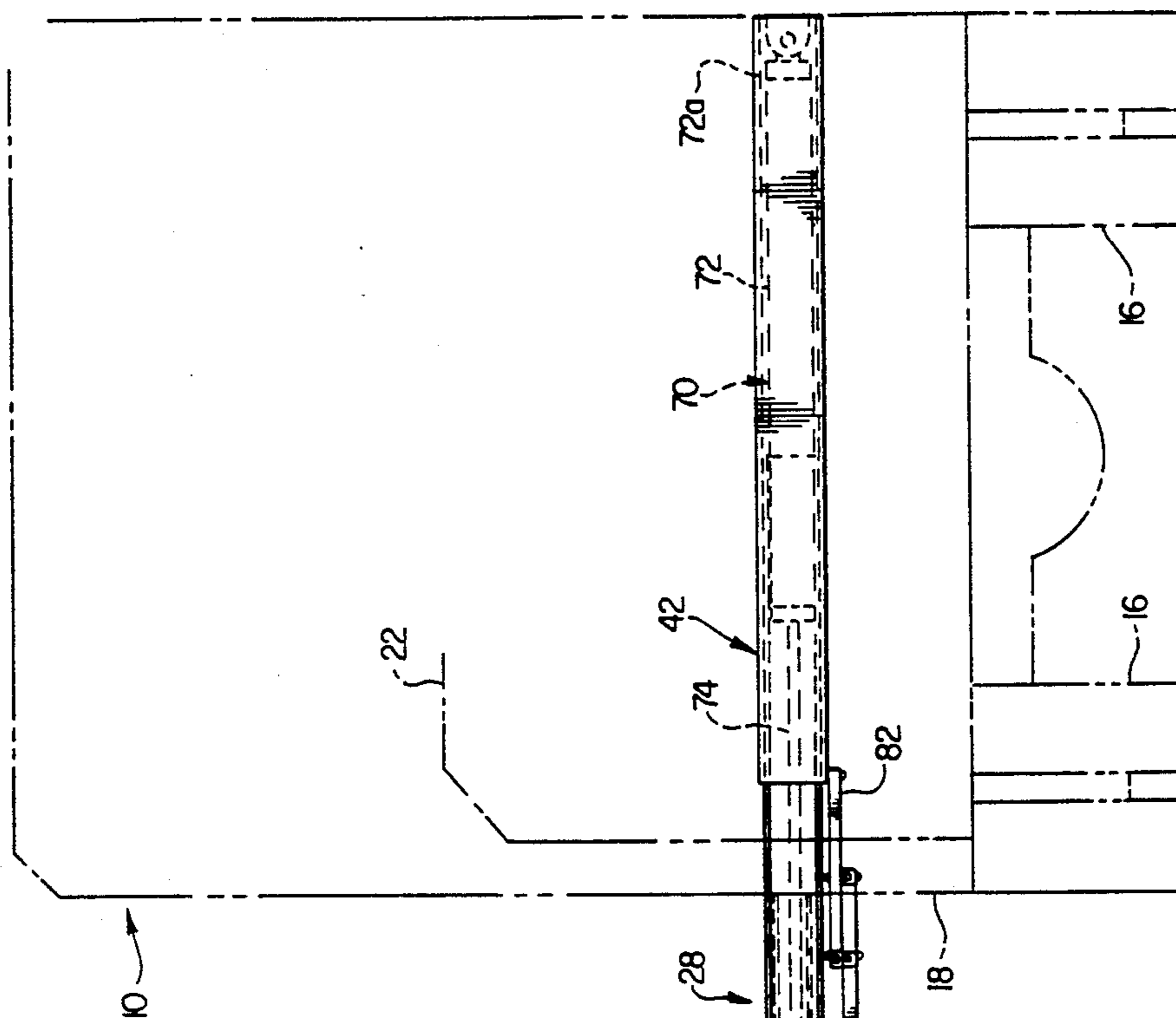


FIG. 3

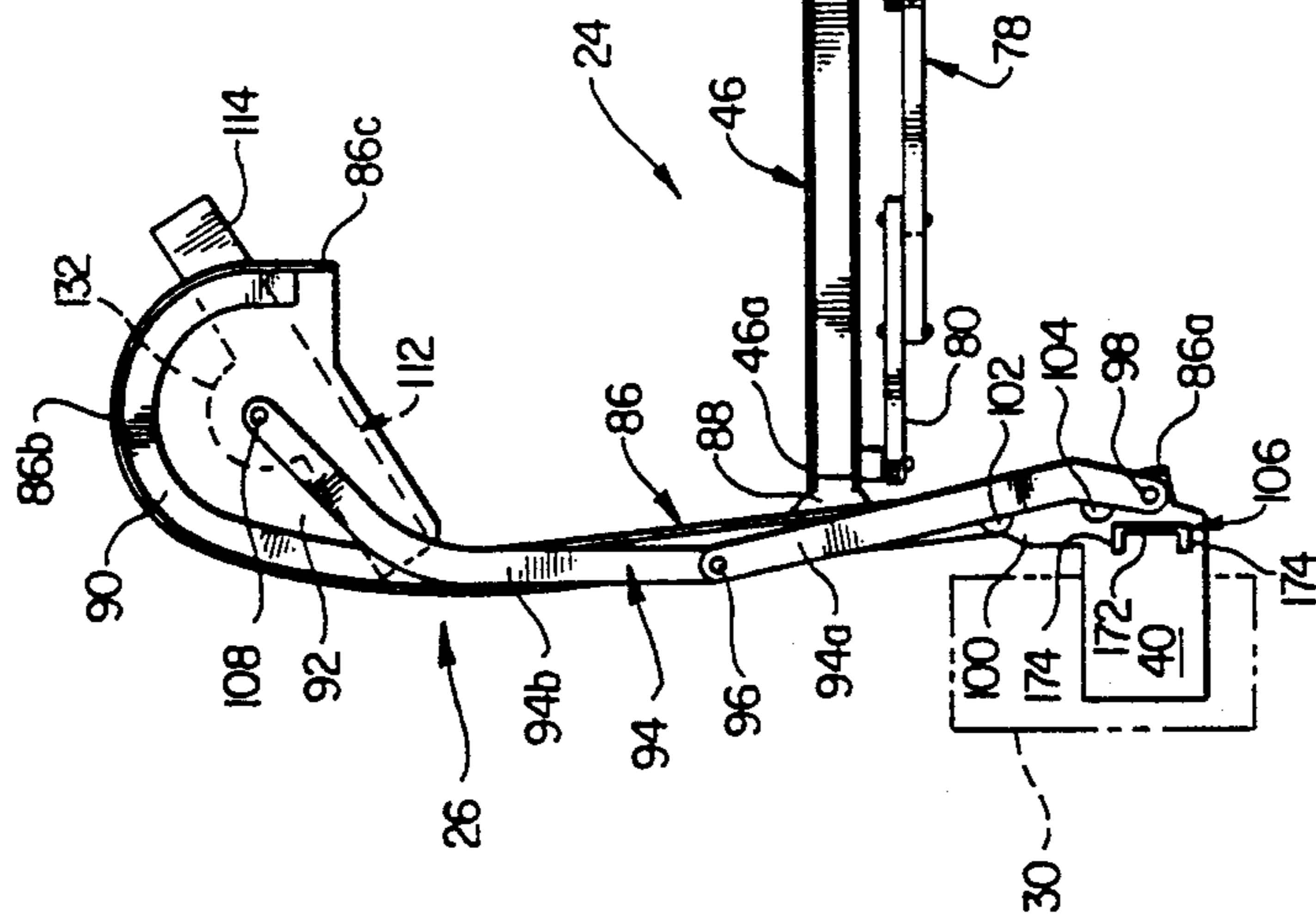


FIG. 4

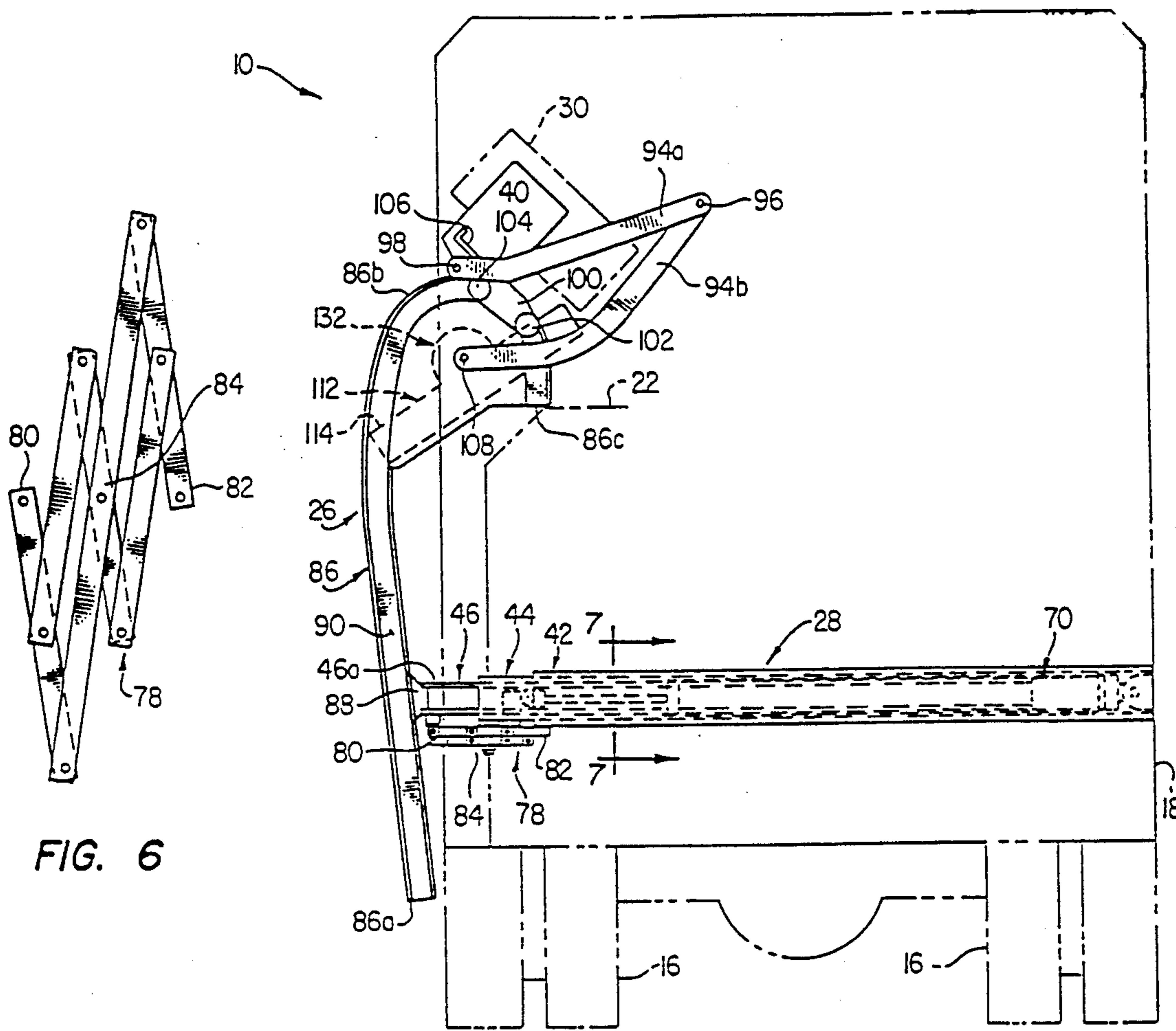


FIG. 6

FIG. 5

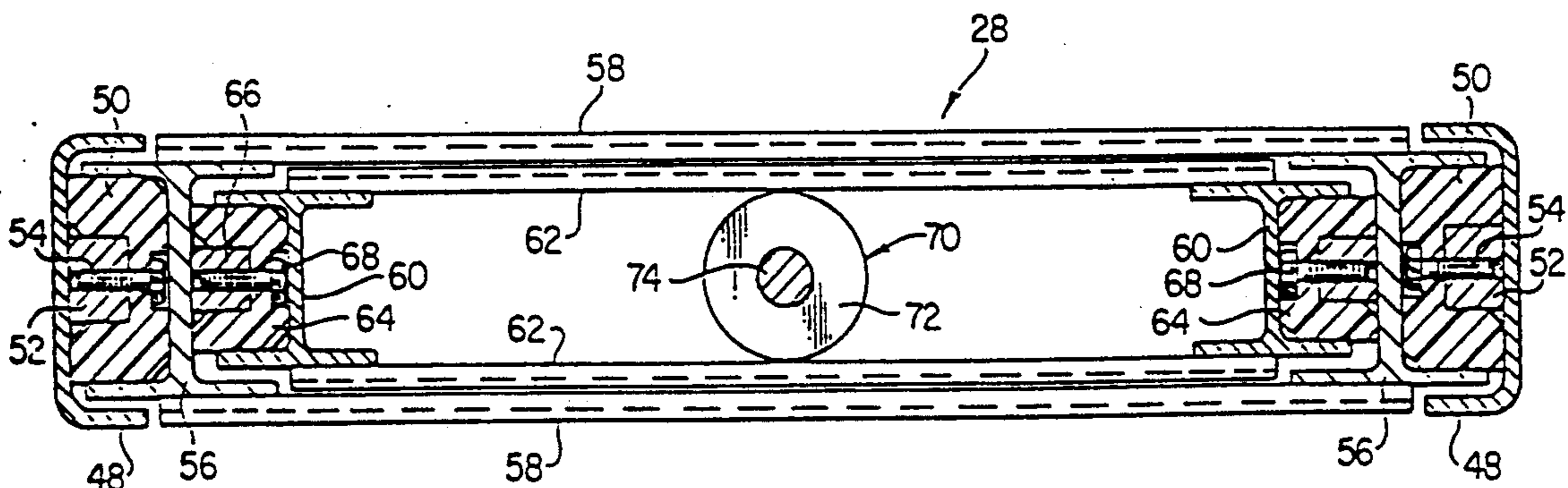


FIG. 7

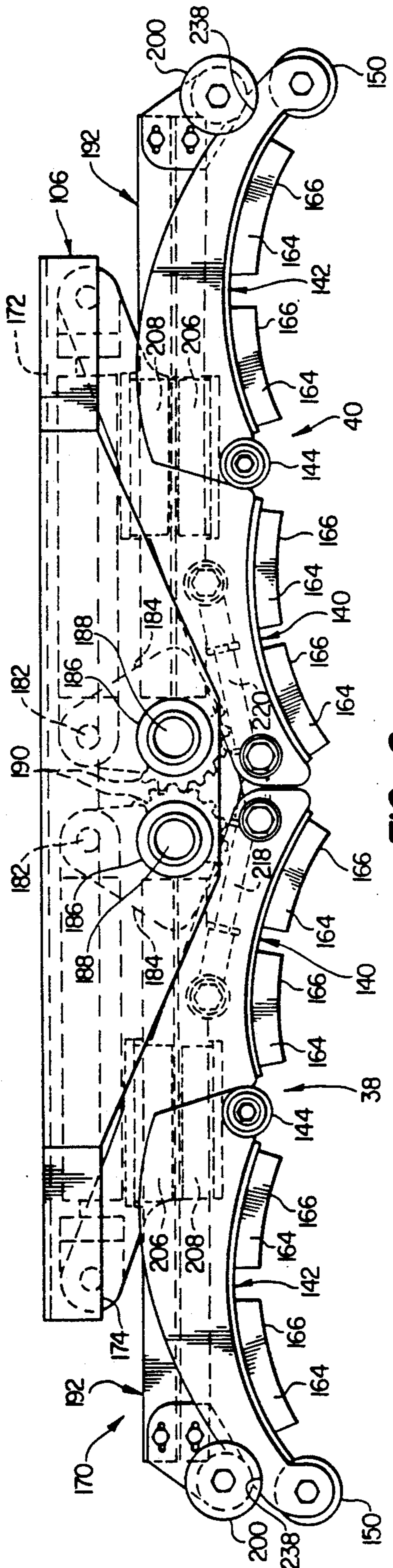


FIG. 8

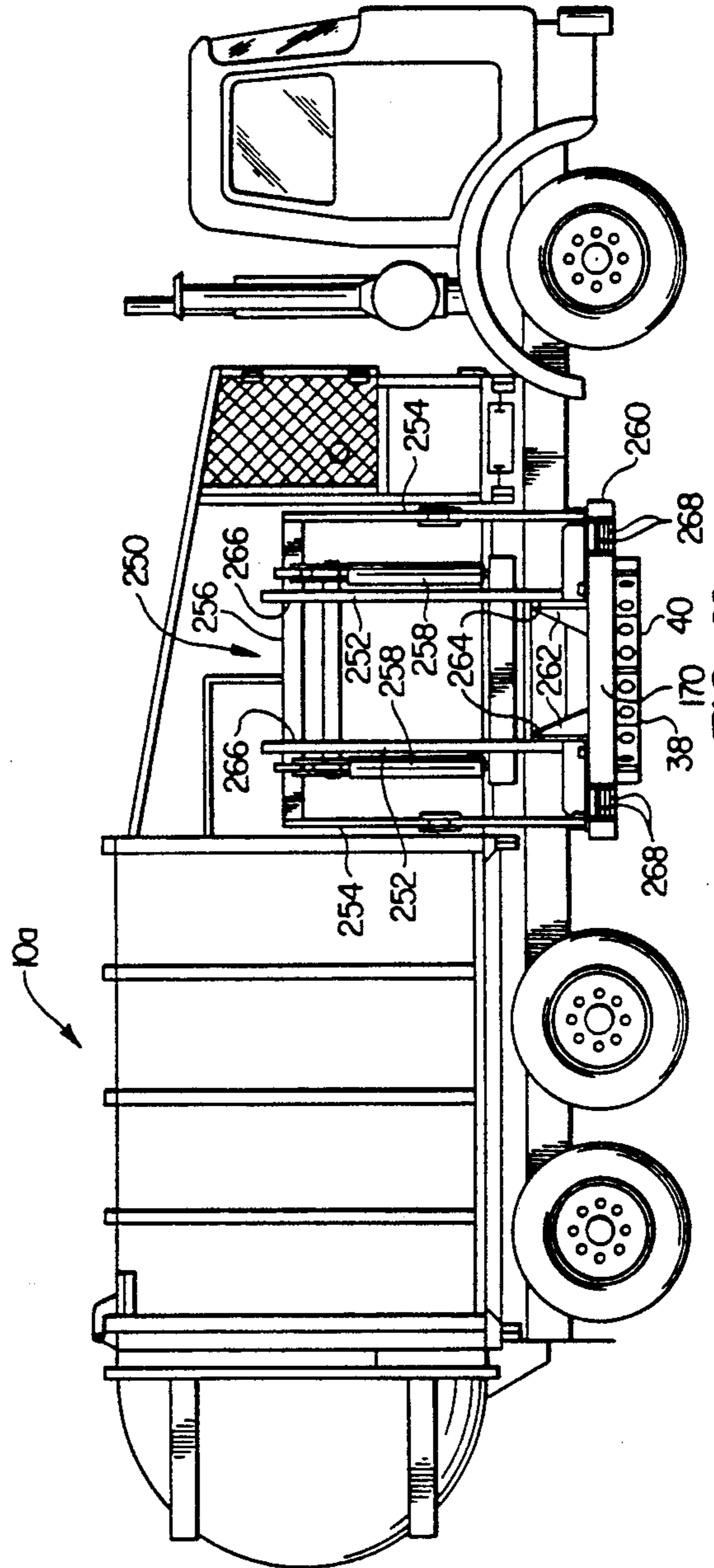


FIG. 11

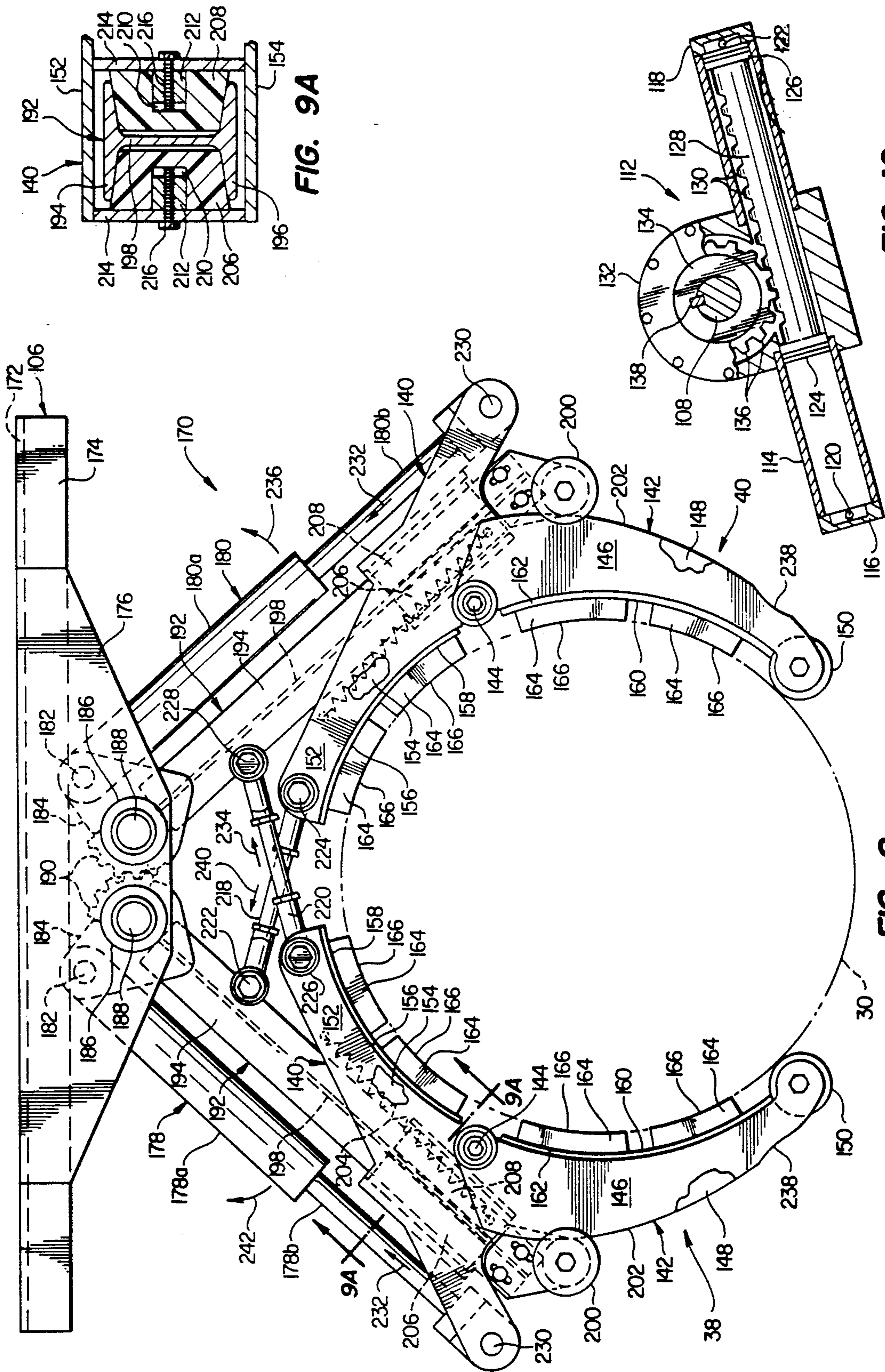


FIG. 9A

FIG. 10

FIG. 9

CONTAINER HANDLING APPARATUS FOR A REFUSE COLLECTION VEHICLE

BACKGROUND OF THE INVENTION

The present invention relates generally to mechanized container handling apparatus operatively mounted on over-the-road refuse collection vehicles, and more particularly relates to improvements in a mechanized refuse container handling system of the general type in which a container grasping structure is horizontally extended outwardly away from the vehicle, engages a refuse container, lifts the container and dumps its contents into the hopper portion of the vehicle, lowers the emptied container back to its original position, and then releases the container.

Mechanized container handling systems of this general type are known in the refuse handling art, and an example of such a system is illustrated in U.S. Pat. No. 4,669,940 to Englehardt et al. While mechanized refuse container handling systems of the type described provide valuable time and labor savings, and generally provide satisfactory operation, they have heretofore had a number of problems, limitations and disadvantages, of which the following are but a few.

For example, the horizontal reach limitation of the systems typically requires that the associated collection vehicle be positioned fairly close to the container, and most systems cannot reach past an end of a car or truck parked at the curb adjacent the refuse container. A similar problem exists when a refuse container is spotted at the curb at a small opening between two cars parked along the curb which limits the amount of space available to reach into the space between the cars to retrieve the refuse container without damaging the cars. Additionally, conventional container handling systems are not typically adapted to selectively handle both cylindrical, relatively small refuse containers and much larger, usually rectangular metal containers. As a result, these systems must usually make a first "run" to pick up one type container, and then be modified to make a second run to pick up the other type of container. Also, the pivoted engagement arms used to lift and engage the cylindrically configured containers contact and grip such containers at only a few widely spaced points around their peripheries, and do not fold back into an essentially straightline position. The operating mechanisms for the container lifting and dumping portion of these systems tend to be fairly complex, large and somewhat difficult and expensive to assemble and dismantle.

In view of the foregoing, it is accordingly an object of the present invention to provide improved refuse container handling apparatus which eliminates or minimizes the abovementioned and other problems, limitations and disadvantages typically associated with conventional container handling systems of the general type described.

SUMMARY OF THE INVENTION

Various aspects of the present invention, by themselves and in combinations with one another and with a refuse collection vehicle, may be utilized to provide improved refuse container handling apparatus of the type operative to lift a refuse container, dump its contents into a hopper portion of the vehicle, and then return the emptied container to its original resting place. Set forth below are brief summaries of various features of the present invention. The sole purpose of

the following summarization is to provide a general overview of the present invention, and is not to be construed as in any manner limiting its nature or scope.

According to one aspect of the invention, the horizontal reach of the container handling apparatus is substantially increased using a container grasping assembly support structure having three interfitted sections—an inner section anchored to the vehicle, and intermediate section horizontally extensible and retractable relative to the inner section, and an outer section horizontally extensible and retractable relative to the intermediate section and having an outer end operative to horizontally move the container grasping assembly. The intermediate section is horizontally driven relative to the inner section, and means are provided for extending and retracting the outer section relative to the intermediate section in response to driven horizontal movement of the intermediate section. The extended reach capability provided by this structure permits the container grasping assembly to be moved past an end of a parked car or the like, if necessary to grasp a container.

According to another aspect of the invention, a pair of articulated container engagement arms are supported for pivotal movement between an open position, in which the arms are essentially straightened and positioned snugly against the vehicle generally within its width clearance profile, and a closed position in which the arms are outwardly pivoted and positioned to extend around a container and grasp it at a series of points extending around a major portion of an essentially circular path. Drivable linkage means are provided to pivot the articulated engagement arms between their open and closed positions. The linkage means are operative in a manner such that the engagement arms, in their closed position, are operative to uniformly grasp cylindrical containers of differing diameters at circumferentially spaced points around their circular peripheries.

According to a further aspect of the invention, horizontally spaced guide means, preferably in the form of vertical mast members, are provided along which container grasping means may be moved to lift, dump and lower a refuse container operatively engaged by the container grasping means. Drive means are provided for moving the container grasping means along the guide means, the drive means being positioned between the guide means and preferably including a fluid drivable actuator gear-connected to articulated force arms rotationally drivable to lift and lower the container grasping means along the guide means. Guide tracks are preferably formed in the outboard sides of the guide means, thereby permitting easy cross-bracing of the guide means.

According to yet a further aspect of the invention, a container grasping assembly is provided for selectively engaging either a generally cylindrical container or a larger, generally rectangular container so that the collection vehicle can handle both types of container in a single pickup run. The dual container grasping assembly preferably includes a linkage-driven pair of articulated container engagement arms, as described above, for engaging the smaller cylindrical containers, and a pair of supplemental container engagement means positioned outwardly of the opposite ends of the engagement arms in their closed, straightened position and operative to engage the larger rectangular containers.

According to a still further aspect of the invention, the various assemblies of a refuse container handling

system are hydraulically driven, and the necessary hydraulic pumps, valves, controls and the like are contained in a modular power pack structure which may be easily removed from the collection vehicle for repair and maintenance purposes. The module may be rapidly connected to and disconnected from the various hydraulic lines of the system by means of quick disconnect fittings operatively secured to the module.

In addition to their individual advantages, when operatively combined with a suitable refuse collection vehicle the above-described features of the present invention provide an overall refuse collection system which is markedly superior to conventional systems of the general type described.

These and other aspects of the present invention are illustrated in the accompanying drawings and are subsequently described in greater detail herein.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a refuse collection vehicle on which container handling apparatus embodying principles of the present invention is operatively mounted;

FIG. 2 is a top plan view of the refuse collection vehicle illustrating the greatly improved horizontal reach capabilities of the container handling apparatus;

FIG. 3 is an enlarged scale side elevational view of the container handling apparatus in a lowered, horizontally extended position thereof;

FIG. 4 is a bottom plan view of an extension scissors structure operatively connected to the container handling apparatus and illustrated in FIG. 3;

FIG. 5 is an enlarged scale side elevational view of the container handling apparatus in a raised, horizontally retracted position thereof;

FIG. 6 is a bottom plan view of the extension scissors structure in its FIG. 5 position;

FIG. 7 is an enlarged scale cross-sectional view through a horizontally extensible and retractable support portion of the container handling apparatus taken along line 7—7 of FIG. 5;

FIG. 8 is an enlarged scale top plan view of an articulated container engagement portion of the overall container handling apparatus, the container engagement portion being in its open position;

FIG. 9 is a view similar to that in FIG. 8 but with the container engagement portion in its closed position;

FIG. 9A shows a cross-sectional view of the linkage arm and sliding block connection between the inner engagement arm segment and the linkage arm on the line 9A shown in FIG. 9.

FIG. 10 is an enlarged, partially elevational cross-sectional view through a lifting/lowering drive portion of the container handling apparatus taken along line 10—10 of FIG. 1; and

FIG. 11 is a side elevational view of a refuse collection vehicle incorporating improved container handling apparatus adapted for selective handling of either relatively small cylindrical refuse containers or much larger, generally rectangular metal refuse containers.

DETAILED DESCRIPTION

Illustrated in FIG. 1 is a motorized refuse collection vehicle in the form of an over-the-road motor truck 10 having an operator's cab 12, and a conventional front steering wheel and axle assembly 14 and tandem rear drive axle and wheel assemblies 16 supporting a frame 18. The frame 18 supports a refuse collection hopper 20

which may include a suitable compaction mechanism (not illustrated). The hopper 20 includes an opening 22 formed in a side wall portion of the hopper for receiving refuse. The truck 10 is of a type typically used for collection of refuse from residential and commercial areas wherein individual containers are set out at the street curb, and adjacent alleyways or driveways for collection. The containers are typically cylindrical, open-topped metal or plastic cans.

Operatively supported on the truck 10 in a manner subsequently described is an improved container handling apparatus 24 which embodies principles of the present invention. Apparatus 24 is mounted on a container elevating and dumping mechanism 26 (see also FIG. 3) that is secured to the outer end of a horizontally extensible and retractable support structure 28 supported by the truck frame 18. In a manner subsequently described, the support structure 28 is operable to move the container and elevating dumping mechanism 26 horizontally between its extended position illustrated in FIG. 3, and its retracted position illustrated in FIG. 5.

Representatively illustrated in FIG. 2 is a cylindrical refuse container 30 set out at a curb 32 generally between a representative pair of cars 34 and 36 parked alongside the curb. To empty the contents of the container 30 into the truck hopper opening 22, the refuse collection truck 10 is pulled outwardly alongside the parked cars 34 and 36 and, in a manner subsequently described, the support structure 28 is moved to its extended position, causing the outer end of the support structure to pass horizontally through the space between the parked cars. After extension of the support structure 28, a pair of articulated container engagement arm structures 38 and 40, positioned at the lower end of the container elevating and dumping assembly 26, are graspingly closed around the container 30. At this point in time, the container elevating and dumping assembly 26, and the extensible support structure 28, are in their orientations depicted in FIG. 3.

Next, as subsequently described in greater detail, the support structure 28 is retracted to its orientation shown in FIG. 5, to horizontally move the container 30 to adjacent a lower side portion of the truck 10, and the elevating and dumping assembly 26 is operated to lift the container 30 to above the hopper opening 22, and tilt the container 30 in a clockwise direction to dump its contents into the hopper opening 22 as illustrated in FIG. 5.

The elevating and dumping assembly 26 is then operated to lower the now empty container 30 to ground level, and the support structure 28 is extended to return the container handling apparatus 24 to its FIG. 3 orientation in which the container is returned to its curbside resting place.

Finally, the container engagement arms 38, 40 are opened to release the container, and the support structure 28 is again retracted to horizontally inwardly move the elevating and dumping assembly 26 to a position closely adjacent the side of the truck 10 facing the cars 34, 36. When this final step is accomplished, and the container handling apparatus 24 is returned to the side of the truck, the apparatus is brought to within the normal clearance width profile of the truck as schematically indicated by the dotted line area 24A in FIG. 2.

At the outset, it should be noted that one of the various advantages provided by the improved container handling apparatus 24 of the present invention is its extended horizontal reach capabilities which permit it

to grasp and handle the container 30 despite the fact that the refuse collection truck is precluded (by the parked cars 34, 36) from pulling directly alongside the curb 32. This extended horizontal reach capability of the container handling apparatus 24 arises through a unique construction and operation of the extensible and retractable support structure 28 which will now be described.

Referring initially to FIGS. 3 and 7, the extensible and retractable support structure 28 includes a horizontally inner section 42 suitably anchored to the truck frame 18, a horizontally intermediate section 44, and a horizontally outer section 46 having an outer end portion 46_a to which a lower end portion of the container elevating and dumping assembly 26 is fixedly secured.

As best illustrated in FIG. 7, the horizontally inner section 42 of the support structure 28 includes a spaced pair of elongated channel members 48 suitably anchored to the truck frame 18 and having U-shaped cross-sections. A pair of elongated slide block members 50 are anchored to the facing side surfaces of the channel members 48 by means of mounting rails 52 and retaining bolts 54.

The horizontally intermediate section 44 of the support structure 28 includes a pair of I-beams 56 slidably carried by the mounting rails 50, as illustrated, and interconnected by transverse channel members 58 welded at their opposite ends to the upper and lower flanges of the I-beams 56. The mounting of the I-beams 56 on the slide blocks 50 permits the intermediate support structure section 44 to move horizontally inwardly and outwardly relative to the stationary inner support structure section 42.

The horizontally outer section 46 of the support structure 28 includes a vertically shorter pair of elongated H-beams 60 positioned laterally inwardly of the I-beams 56 and interconnected by transverse channel members 62 welded at their opposite ends to the top flanges of the H-beams 60. H-beams 60 are slidably mounted on elongated slide block members 64 secured to the vertical webs of the I-beams by mounting rails 66 and retaining bolts 68. Accordingly, the outer support structure section 46 is slidable into and out of the intermediate support structure section 44 which, in turn, is slidable into and out of the inner support structure section 42.

The support structure 28 is horizontally drivable between its FIG. 3 extended position and its FIG. 5 retracted position by a hydraulic cylinder actuator 70 positioned horizontally centrally within the support structure 28 and having a cylinder portion 72 anchored at its rear end 72_a to the truck frame 18 adjacent the right side of the truck as viewed in FIGS. 3 and 5, and an actuating rod portion 74. The outer or left end of the actuating rod 74 is anchored to the intermediate support structure section 44 by a connection block 76 anchored to a longitudinally intermediate portion thereof.

It can be seen by comparing FIGS. 3 and 5 that a hydraulically forced extension of the actuating rod 74 drives the intermediate support structure section 44 outwardly from within the inner support structure section 42, while hydraulic retraction of the actuating rod 74 draws the intermediate section 44 back into the inner section 42. A corresponding outward and inward horizontal movement of the outer section 46 relative to the intermediate section 44 into which it telescopes is achieved by linkage means in the form of an extension scissors structure 78 positioned below the support struc-

ture 28 (see FIGS. 4 and 6) and having an outer end 80 anchored to the outer end 46_a of the outer support structure section 46, an inner end 82 anchored to the inner support structure section 42 adjacent its outer end, and a central portion 84 anchored to the outer end of the intermediate support structure section 44.

The scissors structure 78 operates to extend the outer support structure section 46 relative to the intermediate support structure section 44 in response to driven extension of the intermediate section 44, and to retract the outer section 46 into the intermediate section 44 in response to driven retraction of the intermediate section 44 into the inner support section 42. Scissors structure 78 also functions to equalize the extension and retraction distances of the sections 44 and 46 relative to the support structure section into which they are telescoped. In this manner, the significantly increased horizontal reach of the container handling apparatus 24 previously discussed in conjunction with FIG. 2 is achieved.

Turning now to FIGS. 1, 3, 5 and 10, the structure and operation of the container elevating and dumping assembly 26, which is horizontally moved inwardly and outwardly from the side of the truck 10 by the previously described extensible and retractable support structure 28, will now be described. The assembly 26 includes a horizontally spaced pair of mast members 86 having lower ends 86_a and rearwardly and downwardly curved upper end portions 86_b. Lower portions of the mast members 86, above their lower ends 86_a, are anchored to a horizontally extending support member 88 which, in turn, is rigidly secured to the outer end 46_a of the outer support structure section 46. For purposes later described, laterally outwardly facing guide tracks 90 are formed in the mast members 86 and extend from the bottom end 86_a of each mast member to its downwardly facing upper end 86_c. As viewed in FIG. 1, the guide track 90 in the left mast member 86 is formed along its left side, and the guide track 90 in the right mast member 86 is formed along its right side surface. For purposes later described, support plate members 92 are extended across and anchored to the curved upper portions 86_b of the mast members 86.

The container elevating and dumping assembly 26 also includes a pair of elongated, articulated force arm members 94 positioned outboard of the mast members 86 as best illustrated in FIG. 1. Each of the force arms 94 has, as viewed in FIG. 3, an elongated lower segment 94_a and an elongated upper segment 94_b, the inner ends of each associated pair of arm segments being pivotly interconnected as at 96. The outer or lower ends of the arm segments 94_a are pivotly connected, as at 98, to a pair of support ear structures 100 positioned between each of the force arm segments 94_a and its associated mast member 86. Each of the support ear structures 100 has a pair of roller elements 102, 104 secured thereto and captively retained in the guide track 90 of their associated mast member 86 for rolling movement along the track between the opposite end portions of the mast member.

The support ear portions 100 are suitably anchored to longitudinally spaced apart portions of a horizontally disposed elongated mounting channel member 106 having a generally U-shaped cross-section. In a manner subsequently described, the container engagement arm structures 38, 40 are operatively connected to the mounting channel member 106.

As viewed in FIG. 3, the upper or outer ends of the force arm segments 94_b are fixedly secured to a pair of drive shafts 108 which extend inwardly through suitable openings formed in the support plate members 92, and are rotationally supported on the plate members by bearing structures 110 externally mounted on the plates 92. In a manner subsequently described, inner end portions of the shafts 108 are drivably secured to a hydraulically powered rotary actuator 112 which is suitably mounted between the support plate members 92 at the upper ends of the mast members 86.

As best illustrated in FIG. 10, the rotary actuator 112 comprises an elongated cylinder 114 having closed opposite ends 116, 118 through which hydraulic fluid inlet ports 120, 122 are formed. A longitudinally spaced pair of piston structures 124 and 126 are reciprocally mounted within the cylinder 114 and are anchored to the opposite ends of a rack member 128 having, along its length, a series of upwardly facing teeth 130.

A generally cylindrical housing 132 projects upwardly from a longitudinally central portion of the cylinder 114 and rotatably supports therein an annular pinion gear 134 having peripheral teeth 136 operatively meshed with the rack teeth 130. The inner ends of the drive shafts 108 are received within the central opening of the annular pinion gear 134 and are rotationally locked thereto by key members 138.

Referring now to FIGS. 3, 5 and 10, after the support structure 28 has been horizontally inwardly moved from its FIG. 3 extended position to its FIG. 5 retracted position, the refuse container 30 (which is gripped by the container engagement arm structures 38, 40) is raised from its lowered FIG. 3 position to its FIG. 5 dumping position by forcing hydraulic fluid from a source thereof into the inlet port 122 to leftwardly drive the pistons 124, 126 and the rack member 128 through the interior of the cylinder 114. Such leftward movement of the rack member 128 rotates the pinion gear 134, and thus the drive shafts 108, in a clockwise direction as viewed in FIG. 10. The clockwise driven rotation of the shafts 108 pivots the upper force arm segments 94_b in a clockwise direction away from their FIG. 3 positions to their FIG. 5 positions. Clockwise rotation of the upper force arm segments 94_b lifts the lower force arm segments 94_a while causing them to pivot in a counterclockwise direction relative to the upper force arm segments 94_b and move the force arm segments 94_a to their FIG. 5 position.

The upward movement of the force arm segments 94_a, in turn, lifts the support ear structures 100 (and thus the container engagement arms 38, 40 and the gripped container 30) and moves the roller elements 102, 104 upwardly along the guide tracks 90 to ultimately move the container 30 to the upper end portions 86_b of the mast members 86 and tilt the container 30 to its refuse dumping orientation illustrated in FIG. 5.

To lower the now emptied container 30 to its FIG. 3 position adjacent the bottom ends 86_a of the mast members 86, hydraulic fluid is simply forced into the inlet port 20 at the left end of the cylinder 114 (FIG. 10) to return the rack member 128 rightwardly through the cylinder 114 to cause a counter-clockwise rotation of the pinion gear 134 and the drive shafts 108 to move the articulated force arms 94 from their FIG. 5 orientation back to their FIG. 3 orientation.

The use of the rotary actuator 112, and its inboard mounting between the support plates 92 coupled with the laterally exterior positioning of the roller elements

102 and 104, provide the container elevating and dumping assembly 26 with an essentially unimpeded front side portion extending horizontally between the articulated force arms 94. Additionally, the use of the rotary actuator 112, together with its previously described inboard mounting position, substantially facilitates the installation of the drive portion of the elevating and dumping assembly 26.

Specifically, after the rotary actuator 112 has been suitably mounted between the support plate members 92 at the upper ends of the mast members 86, the drive shafts 108 may be simply inserted inwardly through the support plate openings and rotationally locked to the pinion gear 134. The bearing structures 110 (FIG. 1) may then be simply slid inwardly along the outer ends of the drive shaft members 108 and bolted to the exterior of the plates 92. Finally, the outer ends of the drive shafts 108 can then be fixedly secured to the outer ends of the force arm segments 94_b.

As best illustrated in FIGS. 8 and 9, each of the opposed container engagement arm structures 38, 40 is of an articulated construction comprising inner and outer segments 140 and 142, the inner ends of the outer arm segments 142 being pivotly connected to longitudinally intermediate portions of their associated inner arm segments 140 by pivot structures 144. The outer arm segments 142 are each defined by a vertically spaced pair of elongated, generally arcuate top and bottom plate members 146 and 148 which are secured at their outer ends to roller elements 150. The roller elements and their associated structure comprise camming means to control the articulation of the outer arm segments. The inner arm segments 140 are defined by a vertically spaced pair of elongated, generally straight top and bottom plate members 152 and 154.

The vertical distance between plates 146, 148 is slightly greater than the vertical distance between the plates 152, 154 so that, as illustrated, inner end portions of the plate pairs 146, 148 overlie and are slidable along portions of their associate plate pairs 152, 154. Inner side edges 156 of the plate pairs 152, 154 have a circularly arcuate configuration and have secured thereto similarly curved vertical plates 158. In a similar fashion, the plate pairs 146, 148 have inner side edges 160 having circularly arcuate configurations and a pair of circularly curved vertical plates 162 secured thereto. Radially inwardly projecting arcuate resilient gripping members 164, each having an arcuate inner side surface 166, are suitably secured in circumferentially spaced pairs to the curved vertical plates 158 and 162.

As may be seen by comparing FIGS. 8 and 9, the container engagement arm structures 38, 40 are movable between an open position (FIG. 8) and a closed position (FIG. 9). In their FIG. 8 open positions, the arm structures 38, 40 extend in opposite directions and assume generally straight elongated configurations so that the opened arms 38, 40 may be compactly positioned alongside the truck 10 as may be seen in FIG. 1. In their FIG. 9 closed position, the arms 38, 40 are pivoted to generally arcuate orientations in which the closed arms extend around a major circumferential portion of the refuse container 30 and the resilient members 164 are brought into gripping engagement with the refuse container. Importantly, as can be seen in FIG. 9, the interior side surfaces 166 of the gripping members 164, with the engagement arms in their closed positions, are disposed around an essentially circular arc portion

so that a very uniform circumferential gripping area on the container 30 is advantageously achieved.

The container engagement arm structures 38, 40 are operatively secured to the elongated mounting channel member 106 (see also FIGS. 3 and 5) for movement between their illustrated open and closed positions by a unique, hydraulically actuated linkage system 170 which will now be described in detail with reference to FIGS. 8 and 9. The channel member 106 has a rearwardly disposed vertical base portion 172 from the top and bottom side edges of which upper and lower flanges 174 forwardly project. Secured to the flanges 174 and projecting forwardly therefrom, are a pair of upper and lower, generally trapezoidally shaped mounting plates 176.

The linkage system 170 is driven by a pair of hydraulic cylinder actuators 178, 180 respectively associated with the left and right inner engagement arm segments 140. Actuator 178 has a cylinder portion 178_a and an actuating rod portion 178_b, and actuator 180 has a cylinder portion 180_a and actuating rod portion 180_b. The inner ends of the cylinders 178_a, 180_a are positioned between the mounting plates 176 and are pivoted at points 182 to connection plate members 184 which are welded to hollow cylindrical collar members 186 rotatably mounted on spaced apart pivot pins 188 anchored at their opposite ends to the mounting plates 176. For purposes later described, intermeshing gear teeth 190 are formed around the peripheries of the collars 186.

The linkage system 170 includes elongated I-beam linkage arm members 192 which are positioned inboard of and extend parallel to the hydraulic cylinder actuators 178, 180 as can be best seen in FIG. 9A, each of the I-beams 192 having upper and power flanges 194 and 196 interconnected by a vertical web portion 198. The innermost ends of the I-beams 192 are welded to the connection plate members 184, and the outer ends of the I-beams 192 have roller structures 200 suitably anchored thereto and rollingly engaging the outer side surfaces 202 of the upper and lower plate portions 146, 148 of the outer container engagement arm segments 142. Outer arm segments 142 are pivotally biased into operative engagement with these roller structures 200 by a pair of elongated tension coil spring elements 204 each connected at its opposite ends to an associated pair of bottom plate portions 148 and 154 of the container engagement arm structures 38 and 40.

For purposes later described, each of the I-beams 192 extends between one of the upper and lower plate pair portions 152, 154 of its associated inner arm segment 140 as illustrated in FIG. 9A. Each of the I-beams 192 is slidingly supported between its associated plate pair 152, 154 by a pair of elongated, tapered slide block members 206, 208 extending transversely into the I-beam 192 between its flanges 194 196 on opposite sides of its web 198. The slide blocks 206, 208 have generally rectangular slots 210 extending inwardly from their outer side surfaces, the slots 210 receiving a pair of elongated metal guide rail members 212 suitably anchored to opposed side plates 214 extending between and welded to the upper and lower arms segment plates 152, 154. To adjust the sliding contact between the side blocks 206, 208 and the I-beams 192 which they slidably support, adjustment bolts 216 are threaded into tapped openings formed in the guide rails 212 and have inner ends which bear against the inner sides of the slots 210. The slide blocks 206, 208 may be forced into the opposite side cavities of the I-beam 192 by tightening the

bolts 216, and a looser engagement between the I-beam and the slide blocks may be achieved simply by loosening the bolts 216.

The inner ends of the inner engagement arm segments 140 are cross-connected to opposite I-beams 192 by means of a pair of length-adjustable turnbuckle structures 218 and 220. Specifically, the left end 222 of turnbuckle 218 is fixedly anchored to the left I-beam 192 adjacent its inner end, and the right end 224 of turnbuckle 218 is pivotally connected to the inner end of the right inner engagement arm segment 140. The left end 226 of turnbuckle 220 is pivotally connected to the inner end of the left inner engagement arm segment 140, and the right end 228 of turnbuckle 220 is fixedly anchored to the right I-beam 192 adjacent its inner end. As illustrated, the outer ends of the actuating rods 180_b are pivotally connected, at points 230, to the outer ends of their associated inner engagement arm segments 140.

To describe the unique operation of the hydraulically actuated linkage system 170, it will be assumed that the container engagement arm structures 38, 40 are in their fully closed position as depicted in FIG. 9. With the engagement arms 38, 40 in this closed grasping position, the actuating rods 178_b, 180_b are fully extended, and the roller structures 200 on the outer ends of the I-beams 192 are longitudinally adjacent the outer ends of the inner engagement arm segments 140. Additionally, the hydraulic actuators 178, 180 are downwardly and horizontally outwardly sloped relative to the mounting channel 106 (as viewed in FIG. 9), and the slide block pairs 206, 208 carried by the inner arm segments 140 are positioned adjacent the outer ends of their associated I-beams 192. In this extended reach position it is seen that the inner and outer arm segments which comprise the engagement arms are moved outwardly away from the support member and at the same time pivoted inwardly toward each other to grasp a container spaced some distance away from the support member.

To rearwardly pivot the container engagement arm structures 38, 40 from their FIG. 9 closed positions to their FIG. 8 open positions in which the arms 38, 40 are essentially straightened and positioned parallel to and adjacent the channel member 106, pressurized hydraulic fluid from a source thereof is forced into the cylinders 178_a, 180_a to initiate retraction of the actuating rods 178_b, 180_b as indicated by the directional arrows 232. Retraction of the left actuating rod 178_b exerts, via the left inner engagement arm section 140 and the turnbuckle 220, a generally rightwardly directed force 234 on the right I-beam 192 which initiates a counterclockwise pivoting 236 of the actuator 180, the right I-beam 192, and the right inner engagement arm segment 140 toward the mounting channel member 106. During this pivotal movement 236, the right slide block pair 206, 208 slides leftwardly and upwardly along the right I-beam 192 as viewed in FIG. 9. Also during this counterclockwise pivotal movement 236, the right outer engagement arm segment 142 is pivoted in a counterclockwise direction relative to the right inner engagement arm segment 140 due to the outward biasing force of the right spring elements 204, whereby the right outer engagement arm segment 142 is maintained in contact with the right roller structure 200 which rolls outwardly along the right side edges 202 toward detent indentations 238 formed therein adjacent their outer ends.

A similar movement of the left side of the illustrated linkage system 170 is achieved in response to retraction

of the right actuating rod **180_b**. Specifically, upon such retraction of the right actuating rod **180_b**, a force **240** is generated, via the turnbuckle **218** and the right inner engagement arm section **140**, which acts on the left I-beam **192** to pivot it in a clockwise direction as indicated by the arrow **242**. Clockwise pivotal movement of the left I-beam **192** correspondingly pivots the left actuator **178** and the left engagement arm segments **140** and **142**, the left outer arm segment **142** being maintained in contact with the left roller structure **200**, by the left spring **204**, as the left roller structure **200** rolls along the outer side edges **202** of the left arm segment **142** toward detent depressions **238** formed therein.

Thus it is seen that retraction of the actuating rods causes the pair of articulated arms **38**, **40** to open to move inwardly with respect to the support structure while the pair of inner arm segments **140** slide along the linkage arm members **192** and are retracted and move closer to the support member as the linkage arms **192** move from the angled position of FIG. 9 to lie oppositely in straight line orientation along the support member in the position shown in FIG. 8. The extended grasping position of FIG. 9 is achieved within the space defined by the overall width of the oppositely extended engagement arms in the open position of FIG. 8 because as the linkage arms are pivoted the articulated engagement arms simultaneously come towards each other and slide along the linkage arms as the slide block means connecting the inner arm segments to the linkage arms move from the inner end portions of linkage arms **192** to the outer end portions as shown in FIGS. 8 and 9.

When both of the actuating rods **178_b** and **180_b** have been fully retracted as indicated in FIG. 8, the I-beams **192**, the actuators **178** and **180**, and the container engagement arms **38**, **40** are brought to their open positions, are closely adjacent the channel member **106**, and extend generally parallel to the channel member **106**. The slide block pairs **206**, **208** have been moved inwardly along their associated I-beams **192**, and the roller structures **200** are received in their associated edge detent depressions **238** on the outer arms segments **142**.

To move the container engagement arms **38**, **40** from their FIG. 8 open positions to their FIG. 9 closed positions, the actuating rods **178_b** and **180_b** are simply extended again which reverses the positional sequencing of the linkage system **170** just described.

The previously described adjustable slide block pairs **206**, **208** advantageously function to add rigidity to the linkage system **170**. Specifically, such slide block pairs function to inhibit undesirable horizontal tilting of the arms **38**, **40** relative to the linkage system **170**. The desirable stabilizing effect of the slide block pairs **206**, **208** is maintained throughout the motion range of the engagement arm structures **38**, **40** from their open positions to their closed positions. Pivotal synchronization of the left and right sides of the linkage system **170** is facilitated by the intermeshing gear teeth **190** on the collar members **186**.

It will be readily appreciated that the linkage **170** just described advantageously employs, in a compact fashion, linear force inputs to cause the pivotal and straightening motions of the arms **38**, **40** as they are moved from their open position to their closed position, and create a reverse pivotal and straightening motion of the engagement arms when they are moved from their closed position to their open position. While it is preferable that both of the actuators **178**, **180** be used, it will be appreciated that, due to the unique cross-connection

between the opposed linkage halves, one of the actuators could be eliminated if desired.

For purposes of illustrative clarity, various conventional hydraulic components, such as hydraulic lines, pumps, reservoirs and the like required to operate the previously described container handling apparatus **24** have been omitted from the drawings. According to a feature of the present invention, various key central components of the overall hydraulic system associated with the container handling apparatus **24**, such as pumps, reservoirs, valves and the like are conveniently housed in a removable hydraulic module structure **244** (FIG. 1) detachably mounted on a top front portion of the refuse collection hopper **20** and supported on a suitable frame structure. The various flexible hydraulic lines used to power the container handling apparatus **24** may be conveniently connected to and removed from representative quick disconnect fittings **248** projecting outwardly from the module **244**, thereby permitting the module, and the hydraulic equipment housed therein, to be easily separated from its hopper mounting structure and removed for repair and maintenance purposes. When these tasks are completed, the module **244** may be simply repositioned on its frame structure and the hydraulic lines reconnected to the fittings **248**.

Illustrated in FIG. 11 is a refuse collection truck **10_a** similar to the truck **10** in FIGS. 1 and 2. Operatively mounted on the truck **10_a** is a container handling system **250** similar to that illustrated and described in U.S. Pat. No. 4,669,940 to Inglehardt et al, the apparatus **250** including a pair of vertical mast members **252** positioned inboard of a pair of articulated drive arms **254** connected at their upper ends to an elongated drive shaft **256** extending through upper ends of the mast members **252** and driven by hydraulic cylinder actuators **258** positioned between the masts **252** and the arms **254** as illustrated. The lower ends of arms **254** are secured to the opposite ends of a horizontal support member **260**. A pair of support structures **262** are secured to the member **260** and have roller structures **264** captively retained in guide tracks **266** formed on the inner side surfaces of the masts **252**. As more fully described in U.S. Pat. No. 4,669,940, operation of the actuators **258** causes the support member to be moved upwardly or downwardly along the masts **252**.

Secured to opposite end portions of the support member **260** are horizontally extending pairs of metal pins **268** which may be engaged with the spaced latch hook structures on a typical relatively large rectangular metal trash container, the system **250** being adapted to lift and rearwardly tilt the rectangular container to empty its contents into the hopper portion of the truck **10_a**.

In accordance with a further aspect of the present invention, the previously described container engagement arm structures **38** and **40**, and the previously described drive linkage **170**, are secured to the support member **260**. This incorporation of the arms **38**, **40** and the linkage system **170** into the container handling system **250** advantageously provides it with the ability to handle either cylindrical refuse containers or considerably larger rectangular metal containers without having to adjust or otherwise modify the system to change it over from one type of container to the other.

The foregoing detailed description is to be clearly understood as being given by way of illustration and example only, the spirit and scope of the present invention being limited solely by the appended claims.

What is claimed is:

1. Apparatus for selectively grasping and releasing an object, such as a refuse container, comprising:
 a support member;
 first and second articulated object engagement arm structures each including inner and outer longitudinal segments pivotally connected at fixed points thereon and having inner side portions from which resilient gripping members outwardly project;
 first and second linkage means connecting respectively said first and second engagement arm structures to said support member, said linkage means being responsive to predetermined, generally linear forces exerted on at least one of said engagement arm structures to cause pivotal movement of said engagement arm structures relative to said support member between an open position in which said engagement arm structures are generally straightened and extend in opposite directions, and a closed position in which said engagement arm structures are in a generally opposed relationship, with said outer first and second engagement arm segments being inwardly pivoted relative to their associated inner segments, and said gripping members are brought to positions in which they will engage the object at spaced locations around its periphery;
 said inner engagement arm segment of at least one of said first and second engagement arm structures being supported by sliding support means along an elongated portion of its respective linkage means for sliding supported movement therealong during pivotal movement of said engagement arms between said open and closed positions;
 drive means for exerting said predetermined, generally linear forces on said at least one of said engagement arm structures.
2. The apparatus of claim 1 in combination with an over-the-road refuse collection vehicle.
3. The apparatus of claim 1 wherein:
 said engagement arm structures have inner side surfaces to which a longitudinally spaced series of said resilient gripping members are secured, and said gripping members are positioned around a major portion of a substantially circular path when said engagement arm structures are in their closed position.
4. The apparatus of claim 3 wherein:
 said inner side surfaces of said engagement arm structures, and said gripping members, are arcuately shaped.
5. The apparatus of claim 1 wherein:
 said drive means include a fluid operable cylinder and rod actuator interconnected at opposite ends to said support member and the inner longitudinal segment of one of said engagement arm structures.
6. The apparatus of claim 1 wherein said respective linkage means includes a cam means for camming outer side surfaces of the outer container engagement arm segments to control their pivotal movement during opening and closing of the engagement arms.
7. Apparatus for selectively grasping and releasing an object, such as a refuse container, having a generally circular-cross-section said apparatus comprising:
 a support member;
 first and second articulated object engagement arm structures each including pivotally interconnected inner and outer longitudinal segments having inner

- side surfaces to which object gripping members are secured;
 first and second linkage means connecting respectively said first and second engagement arm structures to said support member, said linkage means being responsive to predetermined, generally linear forces exerted on at least one of said engagement arm structures to cause pivotal movement of said engagement arm structures relative to said support member between an open position in which said engagement arm structures extend in opposite directions, and a closed position in which said engagement arm structures are in a generally opposed relationship, with said outer engagement arm structures being inwardly pivoted relative to their associated inner segments, and said gripping members are substantially entirely disposed around a generally circular arcuate path to inwardly and uniformly grip the generally circularly cross-sectioned object around a major part of the circular peripheral portion thereof;
 said inner engagement arm segments of said first and second engagement arm structures being slidingly supported by sliding support means along an elongated portion of their respective linkage means for slidingly supported movement therealong during pivotal movement of said engagement arms between said open and closed positions so that said engagement arms move outwardly away from said support member and move toward each other to provide an extended reach for gripping said object; and
 drive means for exerting said predetermined generally linear forces on said at least one of said engagement arm structures.
8. The apparatus of claim 7 in combination with an over-the-road refuse collection vehicle.
9. The apparatus of claim 7 wherein:
 said linkage means include means for utilizing a pivotal force imposed on one of said engagement arm structures to create an oppositely directed pivotal force on the other of said engagement arm structures.
10. The apparatus of claim 7 wherein:
 said linkage means include means for pivotally synchronizing said engagement arm structures as they are moved between their open and closed positions.
11. The apparatus of claim 10 wherein:
 said means for pivotally synchronizing include intermeshed first and second gear means each operatively associated with a different one of said engagement arm structures.
12. The apparatus of claim 7 wherein:
 said drive means include fluid operable cylinder and rod actuator means connected between said support member and said engagement arm structures.
13. The apparatus of claim 12 wherein:
 said fluid operable cylinder and rod actuator means are associated with said engagement arm structures for pivotal motion therewith.
14. The apparatus of claim 7 wherein:
 said drive means include a fluid operable cylinder and rod actuator operatively interconnected between said support member and the inner longitudinal segment of one of said engagement arm structures.
15. Apparatus for selectively grasping and releasing an object, such as a refuse container, comprising:

a support member;
 elongated first and second linkage members pivotally
 connected at inner ends thereof to said support
 member and having outer end portions, said first
 and second linkage members being pivotable rela- 5
 tive to said support member between a rear posi-
 tion in which said first and second linkage members
 longitudinally extend in opposite directions, and a
 front position in which said first and second linkage
 members are forwardly pivoted and form an angle 10
 therebetween;
 first and second object engagement arm structures
 each having an inner longitudinal segment and an
 outer longitudinal segment pivotally secured to
 said inner longitudinal segment, said engagement 15
 arm structures having inner side portions to which
 container gripping members are secured, said inner
 longitudinal segments of said first and second en-
 gagement arm structures being respectively se- 20
 cured to said first and second linkage members for
 movement along their lengths, said outer longitu-
 dinal segments of said first and second engagement
 arm structures, respectively, being pivotally out-
 wardly biased into engagement with said outer end 25
 portions of said first and second linkage members;
 a first cross member secured at spaced apart portions
 thereof to said inner longitudinal segment of said
 first engagement arm structure and said second
 linkage member;
 a second cross member secured at spaced apart por- 30
 tions thereof to said inner longitudinal segment of
 said second engagement arm structure and said first
 linkage member; and
 a first extensible and retractable drive structure inter-
 connected between said support member and one 35
 of said inner longitudinal segments of said first and
 second engagement arm structures,
 said first drive structures being retractable to move
 said first and second linkage members to their rear
 positions and move said first and second engage- 40
 ment arm structures to an open position in which
 they are generally straightened and longitudinally
 extend in opposite directions generally parallel to
 said first and second linkage members,
 said first drive structure being retractable to move 45
 said first and second engagement arm structures
 from their open position to a closed position in
 which said first and second engagement arm struc-
 tures are in a generally opposed relationship, with
 said other longitudinal engagement arm segments 50
 being inwardly pivoted relative to their associated
 inner longitudinal segments, and said gripping
 members being positioned to operatively grip the
 object at spaced points around its periphery.
 16. The apparatus of claim 15 in combination with an 55
 over-the-road refuse collection vehicle.
 17. The apparatus of claim 15 wherein:
 each of said first and second cross members has an
 end portion pivotally secured to one of said inner
 longitudinal engagement arm segments. 60
 18. The apparatus of claim 17 wherein:
 said first and second cross members are length adjust-
 able turnbuckle members.
 19. The apparatus of claim 15 further comprising:
 means for pivotally synchronizing said engagement 65
 arm structures during pivotal movement thereof
 between said open and closed positions.
 20. The apparatus of claim 19 wherein:

said means for pivotally synchronizing include inter-
 meshing gear means associated with said first and
 second linkage members and rotatable by said first
 and second linkage members during pivotal move-
 ment thereof between said front and rear positions.
 21. The apparatus of claim 15 wherein:
 the inner longitudinal segments of said first and sec-
 ond engagement arm structures have anchored
 thereto spaced pairs of support slide members
 which respectively and slidingly engage said first
 and second linkage members.
 22. The apparatus of claim 21 wherein:
 said first and second linkage members are elongated
 beam members each having opposite side cavities
 extending along its length and receiving one of said
 spaced pairs of said support slide members, and
 said apparatus further comprises means for laterally
 adjusting said support slide members relative to
 their associated linkage members.
 23. The apparatus of claim 15 wherein:
 said apparatus further comprises a second extensible
 and retractable drive structure interconnected be-
 tween said support member and the other of said
 inner longitudinal segments of said first and second
 engagement arm structures.
 24. The apparatus of claim 23 wherein:
 said first and second drive structures are respectively
 associated with said first and second engagement
 arm structures for pivotal motion therewith.
 25. The apparatus of claim 24 wherein:
 said first and second drive structures are fluid-opera-
 ble cylinder and rod actuators which respectively
 extend parallel to said elongated first and second
 linkage members.
 26. Apparatus for selectively reaching out to grasp
 and retracting to release an object, such as a refuse
 container, comprising:
 a support member which may be fixed to the side of
 a vehicle such as a refuse truck;
 a linkage system comprising a pair of elongated link-
 age arms having inner and outer ends, the inner
 ends being pivotally connected to said support
 member, said arms being pivotable relative to said
 support member between a first position wherein
 said arms are oppositely extended along the sup-
 port member in a generally straightened position
 and a second position wherein the linkage arms are
 pivoted outwardly with the outer ends of the pair
 of arms being positioned outwardly away from said
 support member;
 a pair of articulated oppositely disposed engagement
 arm structures, each engagement arm having an
 inner arm segment and an outer arm segment pivot-
 ally connected to the inner arm segment, the pair of
 articulated arm structures being slidingly mounted
 on said linkage system for movement therewith by
 sliding connections between the inner arm seg-
 ments and the elongated linkage arms so that said
 engagement arms open and are drawn close to said
 support member when the linkage system arms are
 pivoted to the first position and upon pivoting of
 the linkage arms away from the support member,
 said engagement arms simultaneously move out-
 wardly away from the support member and toward
 each other to an extended reach position for grasp-
 ing an object; and
 drive means for pivoting said linkage arms and said
 engagement arms between said first position and

said outwardly angled second position of said linkage arms to simultaneously move the engagement arms outwardly away from the support member and into an extended reach grasping orientation.

27. The apparatus of claim 26 in combination with an over-the-road refuse collection vehicle.

28. The apparatus of claim 26 wherein said respective linkage means includes a cam means for camming outer side surfaces of the outer container engagement arm segments to control their pivotal movement during opening and closing of the engagement arms.

29. The apparatus of claim 26 wherein: said engagement arm structures have inner side surfaces to which a longitudinally spaced series of resilient gripping members are secured, and said gripping members are positioned around a major portion of a substantially circular path when said engagement arm structures are in their closed position.

30. The apparatus of claim 29 wherein: said inner side surfaces of said engagement arm structures, and said gripping members, are arcuately shaped.

31. The apparatus of claim 26 wherein: said linkage system includes means for utilizing a pivotal force imposed upon one of said engagement arm structures to create an oppositely directed pivotal force on the other of said engagement arm structures.

32. The apparatus of claim 26 wherein: said linkage arms include means for pivotally synchronizing said engagement arm structures as they are moved between their open and closed positions.

33. The apparatus of claim 32 wherein: said means for pivotally synchronizing include intermeshed first and second gear means each operatively associated with a different one of said engagement arm structures.

34. A grasping arm assembly for being carried on a supporting structure in an open oppositely extended generally straight line orientation and moveable to a closed position extended away from the support to

structure selectively grasp and release an object, such as a refuse container, the assembly comprising:

a support member capable of being mounted along the side of a vehicle;

a pair of elongated linkage arms having inner and outer end portions, the inner ends pivotally connected to the support member adjacent to each other, the linkage arms being pivotable between an open position in which the linkage arms are extended oppositely in a straight line orientation and a closed position wherein the linkage arms are angled away from the support member toward each other in order to cause engagement arms mounted on each of the linkage arms to grasp a container;

opposed engagement arms for selectively grasping and releasing a container in response to pivotal movement of the linkage arms from the open to the closed position, the engagement arms being oppositely extended from each other when the linkage arms are pivoted to the open position;

first sliding support means for connecting one of the engagement arms to one of the linkage arms and second sliding support means for connecting the other of the engagement arms to the opposite other linkage arm, wherein the engagement arms are slidingly supported by the linkage arms adjacent the inner ends of the linkage arms with the linkage arms pivoted to the open position and slidingly supported by the linkage arms adjacent the outer ends of the linkage arms when the linkage arms are pivoted to the closed position for grasping a container;

drive means for pivoting the pair of linkage arms between the open and closed positions; and

wherein pivotal movement of the linkage arms between the open and closed position causes the engagement arms to slide outwardly on the linkage arms and away from the support member to an extended reach grasping position when the linkage arms are in the closed position so that the combined sliding and pivotal motion of the engagement arms reduces the amount of clear space otherwise required to operate the device.

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UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 5,092,731
DATED : March 3, 1992
INVENTOR(S) : Jones, et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 6, line 20, delete "is achieved." after ". . . FIG. 2 is achieved."

Column 11, line 15, delete "to" after "to open" and add --and--.

Column 14, line 14, delete "struc-" and add --segments--.

Column 14, line 15, delete "tures".

Column 15, line 50, delete "other" and add --outer--.

Column 17, line 45, delete "to" and add --structure to--.

Column 18, line 1, delete "structure".

Signed and Sealed this
Seventh Day of December, 1993

Attest:



BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks